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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
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МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ

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NEWSLETTER

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The ITIC Newsletter brings news and information to tsunami researchers, engineers, educators, community protection agencies and governments in 36 countries. We welcome your news, reports, papers, or abstracts.

Director of Ecuador's INOCAR Arrives at ITIC

LCDR Pedro Cabezas Gonzalez, Director, Naval Oceanographic Institute of Ecuador (INOCAR), arrived in Honolulu on May 18, 1976, for a six-week working visit to ITIC. During this period, Senor Cabezas will familiarize himself with the International Tsunami Warning System and conduct tsunami related research. In addition, he will work on the proposal to the United Nations Development Program (UNDP) for support in establishing a regional tsunami warning system in South America.

LCDR Cabezas is also Chairman of the Committee of Oceans and Atmospheres of the Pan-American Institute of Geography and History (PIGH). It is expected that this visit will be an excellent opportunity to develop the international exchange of information between ITIC and the member countries of PIGH bordering the Pacific.

Senor Cabezas will be returning to Ecuador at the end of June.

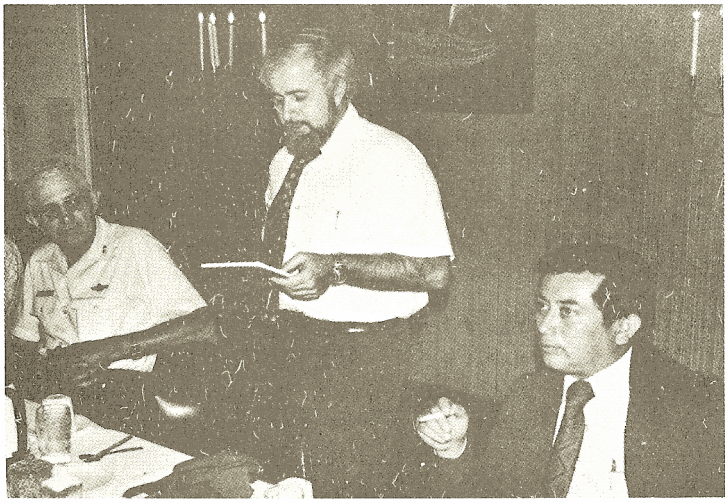
Earthquake Studies in China -- A Massive Earthquake Prediction Effort is Underway

By Robert M. Hamilton; U.S. Geological Survey; Reston, Virginia. (Reprinted from U.S. Geological Survey's Earthquake Information Bulletin, by kind permission of the Editor).

A delegation of American earth scientists visited the People's Republic of China late last year to learn of earthquake research in China. The trip was organized by the Committee on Scholarly Communications with the People's Republic of China, which is sponsored jointly by the National Academy of Sciences, the Social Science Research Council, and the American Council of Learned Societies. A similar delegation of Chinese scientists visited the United States in the spring of 1974 to see current earthquake research efforts in this country.

The American delegation discovered that earthquake research is presently being conducted on a large scale in China. About 10,000 trained, full-time workers and thousands of amateur workers are involved. The primary objective of the Chinese program

Lieutenant Commander Pedro Cabezas, Director, Ecuadorian Naval Oceanographic Institute, Guayaquil, Ecuador (center), at Honolulu International Airport. Mr. Sydney Wigen, Associate Director, ITIC (left), and LTJG Dennis Sigrist, NOAA-NWS (right), greeted LCDR Cabezas upon arrival.



Dr. George Pararas-Carayannis, Director, ITIC, addressing members at the recent tsunami luncheon, Hickam AFB Officers' Club, Honolulu. Looking on are General Valentine A. Siefermann, Director, Hawai Civil Defense (left), and LCDR Pedro Cabezas, INOCAR.

Colonel John Butchart, Vice Director, Hawaii Civil Defense and General Valentine A. Siefermann,Director, Hawaii Civil Defense, at the recent tsunami luncheon. Looking on (center) is Mr. Fred Pugarelli, Public Information Officer for Hawaii Civil Defense.

Dr. V. V. Efimov and Dr. Gaylord Miller of the Joint Tsunami Research Effort, at the tsuami luncheon. Dr. Efimov is visiting JTRE from the Far East Scientific Research Institute in Sakhalin, U,S.S.R.

is to learn to predict the place, magnitude, and time of future earthquakes. A secondary objective is to improve building design to resist earthquake shaking.

The impetus for the Chinese earthquake program came in 1966 when magnitude 6.8 and 7.2 earthquakes struck Hopeh Province, south of Peking, on March 8 and 22, respectively. Some of China's leaders, including Premier Chou En-lai, visited the stricken area. The loss of life and the damage from the 1966 shock provided a vivid reminder of China's long history of earthquake disasters. China holds the record for the greatest loss of life from a single earthquake when at least 820,000 people were killed in Shensi Province in 1556. In 1920, 180,000 people died in the Kansu earthquake.

An unusual aspect of the Chinese earthquake program is the participation of amateur workers. Their activities include monitoring of water level in wells, recording variations in ground tilt and electric currents in the ground on instruments built in the villages, and reporting of abnormal animal behavior. Anomalies in such phenomena have been suggested as premonitory signals for earthquake prediction.

Many modern, well-designed geophysical instruments are deployed throughout China. Seventeen standard seismograph stations with three-component short- and long-period instruments are in operation. In addition, there are about 250 regional seismograph stations. Eight observatories record variations in the Earth's magnetic field. Horizontal land deformation is monitored by trilateration and triangulation surveys, vertical deformation is monitored by level surveys, warping of the Earth's surface is recorded by tiltmeters, and changes in the amount of the radioactive gas radon in water is monitored in wells.

Some examples of the results:

An earthquake of magnitude 4.8 in Yunnan Province on July 17, 1972, was preceded by anomalies in telluric current, water-well level, ground tilt, radon flux, and animal behavior. A prediction was made that a magnitude 5 earthquake would occur within a few days of July 15.

Before an earthquake of magnitude 6.8 in Tsinghai Province in March 1971 the water level at a station on a reservoir dropped 41 centimetres over a period of 1 month prior to the shock, followed by a sudden rise of 21 cm during the 24 hours before the earthquake.

Sixteen cases have been found of anomalies in the ratio of P to S seismic velocities before earthquakes with magnitudes between 3.5 and 6.3. Ten of these anomalies were observed in the Peking area.

Public warnings have been issued for at least 11 earthquakes; it is acknowledged that not all predictions have been successful. The reliability of predictions has not been evaluated, but the fact that in some cases housing has been evacuated before an earthquake shows that the predictions are believed.

Reports have been received that the magnitude 7.3 earthquake that struck in Liaoning Province in north-central China on February 4, 1975, was predicted. People were invited to an outdoor movie shortly before the earthquake struck. Such an achievement represents a remarkable breakthrough in earthquake prediction.

NEWS EVENTS

Galapagos Fracture Zone Earthquake of 29 March 1976

(Reprinted from Event Notification Report from the Center for Short-Lived Phenomena)

On 29 March 1976, a major earthquake occurred in the Pacific Ocean, approximately 800 km northeast of the Galapagos Islands. The National Earthquake Information Service in Golden, Colorado, reported the earthquake had a magnitude of 6.7 on the Richter scale.

In addition, it was reported that the epicenter of the quake was located on the Galapagos Fracture Zone which forms the east-west boundary between the Cocos Plate to the north and the Nazca Plate to the south. At their eastern end, the Cocos and Nazca Plates subduct, or flow under, Central and South America respectively. On the west, the two plates are bounded by the East Pacific Rise in the South Pacific Ocean. New material may accumulate on the plates at the East Pacific Rise, causing the plates to move eastward, and the Galapagos Fracture Zone, causing the plates to spread apart in a north-south direction.

Strong Earthquake Hits Northern Ecuador, 9 April 1976

Honolulu Observatory reported that a strong earthquake of Richter magnitude 6.7 rocked the northern coast of Ecuador at 0709 U.T.C., April 9, 1976. Preliminary reports, issued by National Earthquake Information Service (NEIS), listed 10 deaths and 50 injuries in the coastal town of Esmeraldas, Ecuador. The epicenter of the earthquake was approximately 120 kilometers east of Esmeraldas.

ITIC is presently investigating reports that a local tsunami affected coastal towns close to the earthquake's epicenter. Queries have been sent to gauging authorities in Central and South America, and Mexico, concerning any unusual disturbances generated by this earthquake. Any additional information regarding this possible tsunami would be greatly appreciated by ITIC.

Earthquakes, May 1976

The month of May began with many large earthquakes, both in the Pacific and around the world.

At 1357 UTC, 4 May 1976, a magnitude 6.5 earthquake occurred near the west coast of South Island, New Zealand. According to reports from Honolulu Observatory, the earthquake's magnitude was not sufficient to generate a Pacific wide tsunami. The National Earthquake Information Service (NEIS) stated there were no reports of damage.

The Kermadec Island area of the South Pacific Ocean, struck by two large earthquakes on January 14, 1976, and a magnitude 6.5 earthquake on March 24, was struck by another large earthquake at 0453 UTC, May 5, 1976. According to the Honolulu Observatory, the earthquake's magnitude, again 6.5, was not sufficient to generate a tsunami. There was no damage expected from the earthquake, as it occurred in a sparsely populated area.

Central Europe's strongest earthquake in 13 years occurred in the Alps, south of Munich, Germany, leaving hundreds dead and damaging numerous towns. The May 6 quake, which measured 6.9 on the Richter Scale, occurred at 2000 UTC, and was felt most strongly in the area from Bolzano in the northern Alps down to the northern edge of Rome, and from Yugoslavia to France. Reports continue to list additional deaths and destruction of many towns in northeast Italy.

Earthquake activity continued through mid-May, effecting areas in Greece, Peru, the Soviet Union, and New Britain.

A strong earthquake of magnitude 6.2 struck the southwestern coast of Greece at 1700 UTC, May 11, 1976. This quake occurred about 1000 miles southeast of the earthquake of May 6, in Italy.

Honolulu Observatory recorded an earthquake of magnitude 6.5 occurring at 2156 UTC, May 15, 1976, near north central Peru. There was no evidence that a tsunami was generated by this quake.

Central Uzbek, U.S.S.R., was hit by a magnitude 7.2 earthquake at 0259 UTC, May 17, 1976. According to NEIS, the quake occurred in the same general area in which a large earthquake occurred earlier this year. Early reports indicate there was moderate damage to isolated towns near the earthquake's epicenter. The epicenter of the earthquake was such that a tsunami would not be generated.

An earthquake of magnitude 6.4 hit the area of New Britain Island in the southwest Pacific at 0601 UTC, May 23. Reports from Honolulu Observatory again indicated that no Pacific wide tsunami was generated.

UNESCO/IOC AND UNITED NATIONS REPORTS

Report of ITSU-V Meeting

Dr. Gunter Giermann, Deputy Secretary, IOC, recently provided ITIC with the following information:

The March 1976 issue of ITIC Newsletter contained the report of the ITSU-V meeting as it had been adopted by the International Co-ordination Group in Lima, on 27 February 1976. The Group, however, had authorized the IOC Secretariat to make editorial changes, if it deemed it necessary. An edited and therefore final version has now been issued by the IOC and a copy may be obtained by writing to: The Secretary, IOC, Unesco, 7, Place de Fontenoy, 75700 Paris.

Assessment and Mitigation of Earthquake Risks

The Newsletter has received from UNESCO an abstract from the minutes of the Intergovernmental Conference on the Assessment and Mitigation of Earthquake Risks. This abstract covers the portion of the conference dealing with tsunamis, and will be of concern to participants in the Warning System. For this reason it is reproduced below, in full.

"Item 8.5: Tsunamis

A delegate of the USSR introduced discussion paper SC-76/SEISM/7 (prepared by S.L. Soloviev).

It was noted that while the actual process of tsunami generation has never been observed directly, it was generally thought to be a piston-like movement of the ocean floor. It has also been suggested that large elastic displacements, oscillations of the ocean bottom, sub-aqueous slumping and turbidity currents may be tsunamigenic.

The character of tsunamis depends upon their generation, propagation and transformation at the coast. The theory of their propagation is reasonably well developed, but the details of the transformation at bays, estuaries, etc., is less well understood.

The Secretary of the Intergovernmental Oceanographic Commission described the work of the International Co-ordinating Group for the tsunami warning system in the Pacific and the International Tsunami Information Centre in Honolulu.

The tsunami warning system in Japan was described as a three-part programme of forecasting, warning dissemination and evacuation.

Concern was expressed that tsunami warning systems are inadequate in some countries around the Pacific, where approximately 80% of tsunami damage occurs annually.

In Japan, with its well-developed warning system, it was noted that emphasis is now being placed on the development of major civil engineering structures to protect the shorelines and on the relocation of low-lying villages to higher and therefore safer ground.

Several delegates stressed the need to improve public information services in order to reap full benefit from the existing tsunami warning systems.

Resolution 8.5

The Conference recommends that the Member States concerned take the following action, with the assistance of Unesco and its IOC, of UNDRO and UNDP:

1. Improve and put into operation stable and precise sensors for recording tsunamis in the open sea;

2. Devise and install long-period, broad-band seismographs at seismological stations; continue and complete the automatic processing of seismic data; ensure the integration of hydrophysical and seismological methods of operative tsunami warning;

3. Improve the communication channels used in the tsunami warning system, including the use of satellites;

4. Extend considerably the network of microbarographs and land-based tide gauges;

5. Pursue and further develop the theory of tsunami generation and propagation;

6. Compile schemes of tsunami zoning of the Pacific and other coasts liable to inundation;

7. Carry out reasonable engineering protective measures in the populated localities and exchange technical information through international symposia;

8. Improve public information and awareness of the tsunami threat;

9. Extend the activities of the IUGG tsunami committee, the ITIC, UNDRO and IOC;

10. Extend or create tsunami warning systems in all countries vulnerable to tsunamis."

REPORTS FROM INTERNATIONAL TSUNAMI INFORMATION CENTER - HONOLULU

Acknowledgement

The International Tsunami Information Center is continuing to receive excellent assistance from those individuals and authorities who are supporting our ongoing program for the systematic collection of tsunami data. For example, we have now received tidal records from over forty stations, both international and domestic, recording the tsunami generated by the earthquake of November 29, 1975, on the Island of Hawaii.

ITIC will appreciate receiving analog tidal records of tsunamis from gauging authorities in all countries, whether a specific request has been formally submitted or not.

Central America and Mexico Report

At the conclusion of the IOC/ITSU meeting in Lima, Peru, Sydney O. Wigen, Associate Director of ITIC, visited countries of Central America and Mexico. The trip had several purposes; to meet with national authorities concerned with tide and seismic programs; learn about their previous experience with tsunamis, both from distant sources and from the earthquake zones of the region; seek assistance in providing information and records to ITIC when tsunamis occur; and bring news of the operations of the Tsunami Warning System; and the possibility of developing regional or national warning systems for protection of coastal populations and industries.

Following are extracts from Mr. Wigen's trip report:

"Panama and Canal Zone - February 29 - March 3

Offices were closed for Panama's national Carnival Week, but I was warmly received by Ing. Julio Mock and Ing. Icaza, and given a tour of the facilities of their Instituto Geografico Nacional "Tommy Guardia." Mr. George Richardson, IAGS representative and I inspected the Balboa tide station, part of the Tsunami Warning System, and met the attendant.

At the Canal Zone headquarters of Inter-American Geodetic Survey, Mr. Norman

Fassett and Colonel Carl Rodriguez provided an informative summary of the work of IAGS through Central and South America and gave assurance of continuing cooperation in tsunami programs.

"Costa Rica - March 3 - 6

After arrival in San Jose I was taken by Ing. Jose Chacon and Sr. Antonio Fernandez to Projecto de Caldero, a new planned port facility, and to the Ministerio de Obras Publicas. Ing. Claudio Vieto Rodriguez of Instituto Geografico Nacional provided a report of the 1960 Chilean tsunami as registered at Costa Rica's tidal stations at Quepos and Puntarenas and also records of the November 29 tsunami from Hawaii.

At the University of Costa Rica, Professor Harmon van der Bilt described Costa Rica's seismic zone created by the tectonic plate underthrusting from the Pacific, and outlined plans for a telemetering network of seismic sensors.

"Nicaragua - March 6 - 10

I arrived in Managua on the weekend, and saw the former city center destroyed by the December 1972 earthquake and later, the new city growing around it. At the Deparmento de Navegacion, Ing. Rene Quesada Prado and Ing. Gonzalo Araica outlined their charting and tidal programs, and the development of canals for coastal navigation. They provided tide records for Corinto and Puerto Somoza, showing evidence of the tsunami of November 29. At the Instituto de Investigaciones Sismicas, Ing. Arturo Aburto and Sr. Enrique Lara described the recently established network of 14 stations telemetering earthquake data to the Institute. These sensitive instruments recorded 352 earthquakes in 3 1/2 months, most of them in the active seismic zone off the Pacific Coast.

"El Salvador March 10 - 14

Ing. Jose Gonzales Garcia and Ing. Jose Bustamante of Instituto Geografico Nacional, and Mr. Albert Holburn of IAGS welcomed me to San Salvador. Specific requests were made during discussions for educational materials about tsunamis in English and Spanish, including movies suitable for informing a wide audience through TV broadcasts. We visited the tsunami tidal station at Acajutla where Ing. Jorge Rochac of CEPA, the El Salvador Port Authority, gave us a tour of new facilities. At the Centro de Investigaciones Geotecnicas, Sr. Maximilano Martinez discussed the need for telemetering seismic instruments, and provided a 400 year preliminary catalogue of seismic events.

"Guatemala March 14 - 16

I arrived in the capital two months after the earthquake, and found much reconstruction in progress. Dr. Claudio Urrutia at Observatorio Nacional described plans for new telemetering seismic instrumentation, and gave me a tour of areas struck by the recent earthquake. At the Instituto Geografico Nacional I met Ing. Federico Hernandez Cruz and Ing. Rafael Santiago, and received tidal records from Santo Tomas on the Caribbean coast, showing a tsunami that occurred from the February 4th Guatemala earthquake.

"Mexico - March 16 - 19

At the Secretaria de Marina, Admiral Doroteo Silva Lopez, and Rear Admiral Gilberto Lopez Lira provided information on the tidal stations at Manzanillo and Socorro in the Tsunami Warning System, and the possibility of additional stations for improved protection to the Pacific. With Capitan Lorenzo Perez Aguirre we reviewed the alternatives for fast communication to the gauges. I visited Ing. Jose Saenz at the Panamerican Institute of Geography and History, and learned about proposals for a Central American seismic network. Dr. Cinna Lomnitz at Universidad Nacional Autonoma de Mexico described tidal and seismic programs, and outlined the tectonic processes that may generate tsunamis on the coast of Mexico.

"Summary

Throughout the trip I was warmly and hospitably received, and had productive discussions about many aspects of tsunamis and the Warning System with officials in each of the countries visited. To each country I brought ITIC's publication, "United Nations Assistance in the Establishment of Tsunami Warning Systems in Developing Countries: Guidelines for a Project Proposal," and in 3 countries, visited UNDP offices with local authorities. ITIC is receiving continuing cooperation in developing a better knowledge of seismic events that have occurred in the region, and an evaluation of the threat of tsunamis."

University of Bradford, England, Senior Research Fellow Visits ITIC

Mr. James Lewis, Senior Research Fellow at the University of Bradford's Disaster Research Unit, visited ITIC while enroute from Fiji to England. Mr. Lewis met with LTJG Dennis Sigrist, Assistant Tsunami Specialist, for the Pacific Region, National Weather Service, and they discussed the operation of the Tsunami Warning System in the Pacific. Mr. Lewis expressed interest in tsunamis and their relation to his work in predisaster planning.

The Disaster Research Unit's most recent publication, "Study in Predisaster Planning," is an assessment of hazards and recommendations for a program of precautionary planning in the Bahama Islands.

Mr. Lewis' group believes "...that precautionary planning should be made to involve long-term development planning and should include precaution in land use, building construction, in physical precautions, and contingency planning and relief planning in administrative precautions. Warning systems, promulgation of warnings and the achievement of response are very much part of 'social precautions' as we see them, all in a comprehensive and integrated multidisciplinary precautionary strategy."

Visit by Dr. Vladimir Efimov of the USSR

Dr. Vladimir Efimov of the Sakhalin Scientific Complex, Academy of Sciences, USSR, arrived in the USA on April 10 for a three-month visit to the Joint Tsunami Research Effort. He is working with Drs. Robert Harvey and Gaylord Miller on the results of the joint USSR/USA cooperative cruise in the Kuril/Hokkaido area.

Preliminary results indicate that, in the area in which the experiment was conducted, the main energy in the tsunami frequency range of from 1 to 3 cycles per hour is in the form of a South-West propagating lowest-mode edgewave. This is in contrast to results of a similar study off the coast of California in which the long-period wave activity in the tsunami frequency band in the absence of a tsunami was equally divided between North and South propagating edgewaves.

A second research topic is to model the tides giving results obtained from the deep ocean along with the shoreline gages for which constants have been determined for the Kuril and Hokkaido areas. A regional co-tidal chart will then be derived from this modeling from the area within a few hundred kilometers of the southern Kurils and Hokkaido. We are also scanning the data for any extremely small tsunamis which might have been detected but with no positive results thus far.

Current plans are for Dr. Efimov to leave Hawaii near the end of June and proceed to Scripps Institution of Oceanography of the University of California. He will spend a few days there visiting scientists with interests similar to his own and deliver a seminar on the cooperative USSR/USA tsunami experiment. He will then continue on to Washington, D.C. prior to returning home.

Australian and Alaskan Visitors Tour Honolulu Observatory

LT Robert Losey, a NOAA Commissioned Officer, and Mr. Albert Comiskey of the National Weather Service Alaska Regional Office recently toured NOAA's Honolulu Observatory. Mr. Thomas Sokolowski, Honolulu Observatory's Acting Chief, and LTJG Dennis Sigrist, Assistant Tsunami Specialist, provided a tour for the visitors.

LT Robert Losey joined the NOAA Commissioned Corps in 1972 after graduating from the Colorado School of Mines. He is stationed in Australia as a solar observer at the Culgoora Solar Observatory. This observatory is part of a Flare Patrol Network to keep a constant watch on the sun in order to report energetic solar emissions which can affect the earth's ionosphere and magnesphere. His visit to the Tsunami Warning Center was taken en route from annual leave to the mainland.

Mr. Comiskey is the Chief of the Environmental Services Branch of the NWS Alaska Region. His visit was in conjunction with a family vacation to the Islands.

Director of Mineral Resources, Fiji, Visits ITIC

Mr. Ronald N. Richmond, Director of Mineral Resources for Fiji, visited ITIC on May 8th. His principle concern was to review aspects of the Tsunami Warning System and of ITIC services that are relevant to Fiji's requirements.

Fiji has a population of about one half million, distributed over 300 islands in a 1000-island archipelago. The Islands are vulnerable to locally produced tsunamis, to those from adjacent areas such as Tonga Trench, and to large ones originating in distant parts of the Pacific. Mr. Richmond wants to see a national capability developed in Fiji for rapid response in the event of a locally produced tsunami. The Islands are seismically active, and one earthquake in 1953 produced a tsunami that caused a number of deaths.

Tsunami Warning System Telecommunications Network

Mr. Myron Kerner, Communications Specialist with the National Weather Service, has kindly provided ITIC with this article on the TWS telecommunications network.

Honolulu Observatory, the hub of the TWS, sends out queries to tidal and seismic stations up to 6000 miles distant and can receive replies essentially within an hour. This is no small feat, one that does indeed involve the most efficient of telecommunications.

Instead of attempting to establish a separate system that would, to a large extent be a duplication, the Observatory uses existing communications channels. These channels are under management and control of various civil and military agencies, both domestic and foreign, and are used by mutual agreement, with these agencies authorizing the highest precedences.

Honolulu Observatory has direct access to the worldwide Aeronautical Fixed Telecommunications Network (AFTN), which is operated by the Federal Aviation Administration within the United States area of control, and the Military Automated Digital Network (AUTODIN). Computer processed tapes are entered directly into these networks for automated relays to the various stations in the widespread tsunami network, either directly or by subsequent relay via other systems; chiefly the dedicated meteorological channels. Thus, prompt two-way communications are available with the coastal areas from Kamchatka, to Japan, Hong Kong, the Philippines, then down through Noumea, New Zealand, over to South, Central, and North America and many of the Pacific Islands in between Guam and the Trust Territories such as Marcus, Wake, Fiji, Christmas Island.

It would be too much to go into all of the various routings involved, but we can briefly describe a few examples. Messages to both Kharbarosk and Hong Kong go much the same circuitous, however expeditious, routing. Starting from Honolulu Observatory they are entered into the AFTN for transmission to the NWS communications computer at Suitland. Next, they are entered onto a direct circuit to Tokyo for automatic switching on dedicated meteorological channels to Kharbarosk and Hong Kong. This is a long way around, but the relays are near instantaneous. The return route is, of course, the same in reverse. Similarly, exchanges with La Plata, Argentina, originate as AFTN messages to National Meteorological Center for relay via the meteorological channel to Argentina. A bit more involved are the communications with Easter Island, in the southeast Pacific. Honolulu Observatory enters these messages into the AUTODIN system to the Goddard Space Flight Center, Greenbelt, Maryland, for relay via NASA communications to the minitrack station in Chile for relay by radiotelephone to the University of Chile at Santiago for subsequent radiotelephone relay to Easter Island. A message going to Truk in the Caroline Islands is a bit more straight forward. It starts as an AFTN message addressed to Saipan, with only one automated relay en route. At Saipan it is relayed by torn tape onto the radio circuit to Truk.

To keep the system operating at peak efficiency, "dummy" test messages are exchanged at least twice monthly, with over 50 stations in all.

Of course, members of the TWS are looking forward to the day when some of these circuitous paths can be replaced by direct communications point-to-point via the GOES satellite. Ultimately, the occurrence of events, both seismic and tidal, will trigger warning messages in real time.

Philippines Propose Second Tsunami Tide Station

The Philippine Bureau of Coast and Geodetic Survey has announced it has taken steps to include their Davao Tide Station in the Tsunami Warning System. They are presently in the process of preparing primary and alternate routes of communication between Honolulu Observatory and Davao.

The Republic of the Philippines, composed of many large islands and thousands of smaller ones, is in an area that is highly susceptible to tsunamis. Their inclusion of the Davao Station will not only enhance the effectiveness of the International Tsunami Warning System but will, also, provide timely warnings of local tsunamis. The tide station at Legaspi has supported the Tsunami Warning System since 1961.

Automated Tide Gauge Installation on Potomac in Washington, D.C.

The National Ocean Survey and the National Weather Service, of the National Oceanic and Atmospheric Administration, have cooperated in the automation of the Washington, D.C., tide gauge.

An NWS Device for Automatic Remote Data Collection (DARDC) was installed on the NOS control tide gauge, and now, anyone with an eight-level data terminal connected to a telephone can obtain the tide height by dialing the phone number assigned to the tidal station.

The DARDC Tide installation was made to test the dependability of the system for operational collection of tide level information. If successful, it will increase both NOS and NWS capability to monitor the tide gauge network for data collection or data quality. The DARDC system could be used in the eventual automation of the Tsunami Warning System at certain tidal stations. The T.W.S. station at Tofino, B.C., Canada, uses a similar type of remote telephone interrogation device and has been quite successful.

NATIONAL AND AREA REPORTS

Philippine Islands Earthquake and Tsunami of October 31, 1975

The severe magnitude 7.4 earthquake of October 31, 1975, occurring northeast of Samar Island, Philippine Islands, as reported in the December 1975 ITIC Newsletter, generated a tsunami that was recorded as far away as Japan and Wake Island.

The Philippine Bureau of Coast and Geodetic Survey has sent ITIC an account of a local tsunami, and a marigram from the Legaspi Tsunami Warning Station showing a

tsunami wave of approximately one foot. According to the report, people living on the eastern coast of Samar Island and Catanduanes stated that waves of five to ten feet were experienced. Additional reports indicated some damage was caused by the tsunami. The Philippine Bureau of Coast and Geodetic Survey will have an official report forthcoming, which will be mentioned in a future ITIC Newsletter.

The Japan Meteorological Agency has kindly provided ITIC with tidal information regarding the tsunami from this earthquake as recorded in Japan.

The following tabulation indicates stations recording a tsunami from this earthquake:

STATION	TIME OF ARRIVAL OF FIRST WAVE (U.T.C.)	MAXIMUM WAVE HEIGHT (CM) CENTIMETERS
Legaspi, Philippines (TWS)	0903	28
Okinawa, Japan (TWS)	0940	10
Yap (TWS)	1020	6
Chichijima, Japan	1136	25
Murotomisaki, Japan	1157	12
Tosashimizu, Japan	1206	22
Mera, Japan	1254	36
Omaezaki, Japan	1336	30
Choshi, Japan	*	50
Kushimoto, Japan	*	46
Wake Island (TWS)	1425	6

* - Initial wave arrivals not clear.
(TWS) - Participating tide station of the Tsunami Warning System.

Seismic Sensors to be Installed Throughout Hawaii

The Hawaii State Civil Defense is presently installing seismic alarms throughout the Hawaiian Islands. These seismic alarms will become an integral part of the Hawaii Regional Tsunami Warning System and will enable local authorities to respond quickly to large and potentially tsunamigenic earthquakes by evacuating people from dangerous coastal areas.

Presently, seismic alarms have been installed at; National Weather Service offices in Hilo, Hawaii, and Honolulu, Oahu; and local police stations in Captain Cook, Hawaii, and Wailuku, Maui. Additional units will be installed at Kamuela, Hawaii; Hana, Maui; and two units each on Kauai and Oahu Islands.

The seismic alarms have been calibrated to switch on for local earthquakes of magnitude 6.5 or greater which is considered the lower earthquake threshold limit for the generation of destructive tsunamis in the Hawaiian Islands. The instruments have been developed by researchers at the University of Hawaii and Indiana University, and have been designed to sound an alarm and activate a light, indicating that an earthquake of tsunamigenic potential has occurred.

The Tsunami Seismic Switch (Alarm)

Dr. William M. Adams, Professor of Geophysics, University of Hawaii, has kindly provided ITIC with this description of the Tsunami Seismic Switch.

The UHIU Tsunami Switch (UHIU stands for University of Hawaii-Indiana University) is an instrument that has been conceived at the University of Hawaii, designed and constructed at Indiana University, and funded by the State of Hawaii Civil Defense. The purpose of the UHIU Tsunami Seismic Switch is to assist public officials in discriminating between those earthquakes that are potentially tsunamigenic and those that are not potentially tsunamigenic.

The instrument consists of a sensor, a display, and a connecting 19-conductor cable. The sensor contains an inverted compound pendulum which is used to provide the relatively stable reference point for vibrations of about 1.3 Hertz. Horizontal motion of the ground will cause digital signals which are subjected to logical evaluation. For example, three interruptions within a given time duration may be required. The time window within which the pulses must occur may be varied from about ten seconds to about ten minutes per pulse.

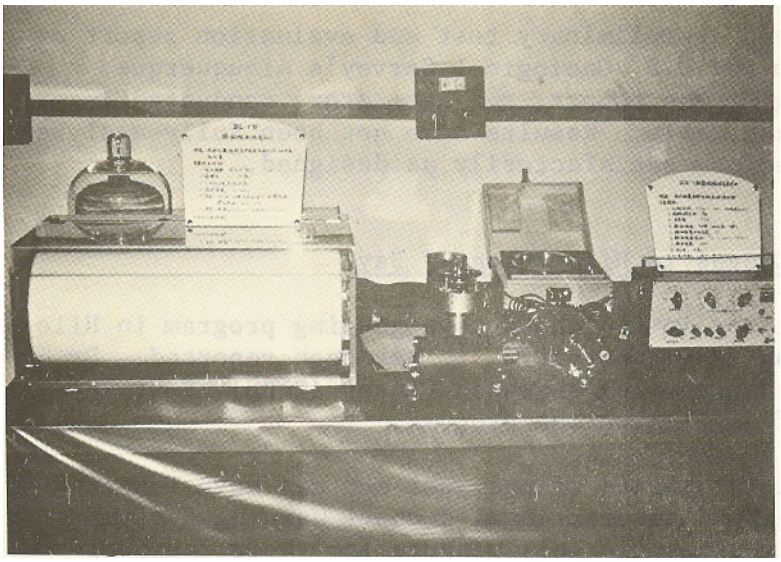
The output of the logic circuitry is cabled to a display unit located in a place subject to continuous surveillance and is used to set off an alarm consisting of an intermittent 2900 Hertz audio signal and a red light labeled "alarm."

Additional circuitry is provided for testing the electronics and for resetting the system. Stand-by power is provided for operation under loss of line-power up to about ten hours.

Calibration of the UHIU Tsunami Seismic Switch is presently being conducted on "shake-tables" by the Albuquerque Seismological Laboratory of the United States Geological Survey.

The UHIU Tsunami Seismic Switch may also be useful for other situations requiring a high-reliability seismic switch, such as shutdown of nuclear reactors, turn-off of power lines to high-speed commuter trains, closure of gas-line valves, etc.

Additional installation of these units will permit local authorities on each island to pass warning information rapidly and accurately. This warning information will be derived from earthquake magnitude alone, as the time necessary to determine magnitude and epicenter by conventional means is critical in a locally generated tsunami. The warning information will be augmented by the Honolulu Observatory which maintains overall responsibility for the Regional Tsunami Warning System. The Honolulu Observatory, on the basis of its instrumentation and assessment of a local large earthquake may upgrade or cancel a tsunami warning.

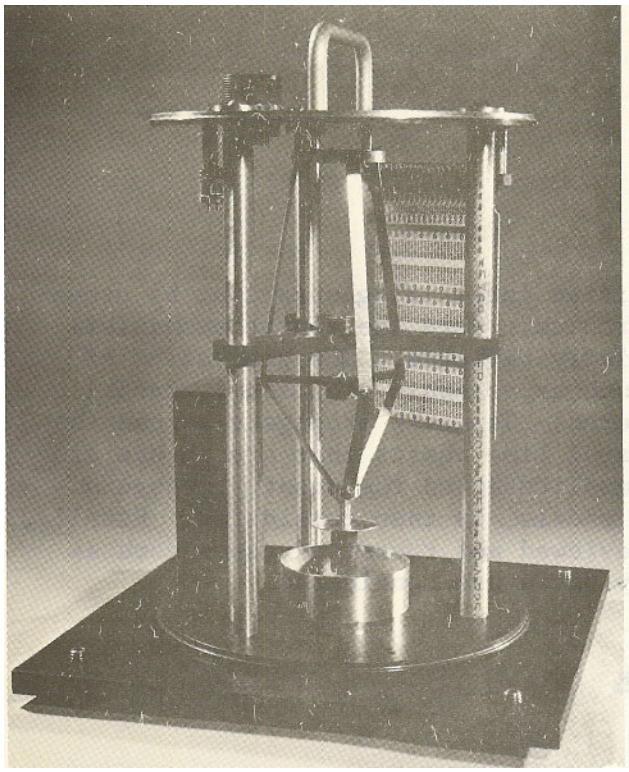


EARTHQUAKE STUDIES IN CHINA

One of the new portable seismographs being constructed at the Peking Seismograph Factory. High-gain response is in the 10 to 15 Hertz frequency range. The recorder,on the left, uses pen and ink.

(photo: USGS)

UHIU TSUNAMI SWITCH/ALARM



(photo: courtesy W. M. Adams)

The University of Hawaii - Indiana University Tsunami, Switch, sensor unit, uncovered, exposing inverted compound pendulum mechanism. Logic circuity is located on circuit board.

TSUNAMI TIDE SYSTEM INTERFACE UNIT

As reported in our last Newsletter, the Albuquerque Seismological Laboratory has successfully completed installation and testing of the advanced Tsunami Tide System in San Diego, California. The $5,000 digitizer/encoder, pictured above, interfaces the tide sensor with the satellite transceiver unit.
(photo: USGS)

Editor's note: ITIC has just received a preliminary test and evaluation report of the UHIU Tsunami Seismic Switch from the U.S. Geological Survey's Albuquerque Seismological Laboratory. According to the report, the Laboratory conducted tests on two individual units on their shake table. Results have not been fully analyzed, but it is expected the units will perform satisfactorily as designed.

Corps of Engineers to Install Tide Gauges in Hilo (Hawaii) Bay

The U.S. Army Corps of Engineers will be initiating a wave gauging program in Hilo Bay on the Island of Hawaii beginning in October 1976, it has been reported. Dr. Lee Harris of the U.S. Army Coastal Engineering Research Center (CERC), Fort Belvoir, Virginia, will be in charge of developing the program.

These gauges will be used for an initial period of one year and may have future possible uses for the Hawaii Regional and International Tsunami Warning Systems. The State of Hawaii has expressed enthusiasm in this venture for their regional tsunami warning needs. Dr. George Pararas-Carayannis, Director of ITIC, will be in contact with Dr. Harris during the development of the system.

ABSTRACTS AND RESUMES

The Dynamics of Tsunamis

T. S. Murty
Ocean & Aquatic Affairs
Department of the Environment
Ottawa, Canada

The dynamics of tsunamis can be broadly classified into: a) generation; b) propagation across the ocean; and c) the coastal problem. Here the source mechanisms for the seismic generation of tsunamis are briefly reviewed. The generation of tsunamis by sources other than earthquakes, such as volcanic explosions, landslides, and underground nuclear tests are also considered. Tsunamis propagate across the oceans in the form of long gravity waves. Travel time charts that are in use are briefly reviewed. The prediction of tsunami amplitudes on the coast, through numerical models, and empirical and statistical models, is then considered. Finally, the present day tsunami warning systems are reviewed and recent advances such as using T-phase and atmospheric internal gravity waves are considered.

On a Stochastic Model to Estimate Tsunami Risk

Octavio A. Rascon & Augusto G. Villarreal
Faculty of Engineering
Universidad Nacional Autonoma de Mexico
Mexico, D.F.

For the design of a coastal protection where the Lazaro Cardenas-Las Truchas steel factory is being built, a statistical study was carried out on the tsunamis that

have reached the Mexican Pacific coast in order to evaluate probabilities of exceedance of the maximum wave height during tsunamis. The study was done using Bayesian estimation. Results obtained were the relation between the maximum height and the mean exceedance frequency of the waves for this coast, and the probability distributions of the maximum wave height for any randomly selected site and for Las Truchas, corresponding to any period of time.

A Historical Summary of Earthquake Epicenters In and Near Alaska

Herbert Meyers
National Geophysical and Solar-Terrestrial Data Center
Environmental Data Service, NOAA
Boulder, Colorado 80302

This report was prepared in support of the Bureau of Land Management NOAA Outer Continental Shelf Environmental Assessment Program for Alaska. It contains map plots and tables that summarize the earthquake activity during recorded history, and is intended to permit researchers, engineers, and environmentalists to assess independently the earthquake risk for any specific locality in Alaska.

Copies of the report may be obtained from the above address.

Catalog of Tsunamis in Alaska - Revised 1976

Doak C. Cox and George Pararas-Carayannis
with revisions by Jeffrey P. Calebaugh
World Data Center A for Solid Earth Geophysics
National Geophysical and Solar-Terrestrial Data Center/NOAA
Boulder, Colorado 80302

This catalog is mainly a reprint of a 1969 document with the same title. However, to the original document has been added information on 12 tsunamis reported for the period 1967-1974, together with some changes and additions for past events, and reference maps. The earliest tsunami catalogued occurred in 1788.

Copies of the publication can be obtained from the Data Center at a cost of 80¢.

"Tabla Cronologica Preliminar de los Terremotos Mas Intensos en El Salvador"

Tomas Fidias Jimenez
Departamento de Sismologia
Ministerio de Obras Publicas
Apartado Postal 06-109
San Salvador, El Salvador

This catalog, unpublished, gives a brief account of more than 70 major earthquakes and eruptions that have occurred in El Salvador since the year 1520.

Specifically related with tsunamis, the catalog points out the 1902 "Terrible tsunami which cause the ruin of the villages of Costa de Ahuachapan, Barra de Santiago, Cara Sucia and Garita Palmera."

Wave Reporting Procedures for the Observers in the Tsunami Warning System

Intergovernmental Oceanographic Commission
United Nations Educational, Scientific and Cultural Organization
Publication No. ISBN 92-3-101357-1

The purpose of this publication is to provide general information and specific instructions to aid tide observers in reporting tsunamis. Both regular tide observers and alternate or substitute observers at participating tide stations should be familiar with procedures outlined, which have been approved for international use by the Intergovernmental Oceanographic Commission.

Tsunamis - Alles verwoestende vloedgolven

A. R. Ritsema
Natuur en techniek - Vol 44, Mar'76
Amsterdam, Holland

This article, in Dutch, gives a comprehensive description of tsunamis, their source and generation, propagation, and runup. Included are photographs of tsunami damage and of the Honolulu Observatory, and information on the Tsunami Warning System for the Pacific.

Datos Geofisicos

Serie A
Oceanografia 2
Instituto de Geofisica
Universidad Nacional Autonoma de Mexico

This publication shows graphically, the variations caused on mean sea level by different seismic and meteorological phenomena originating during the 1952-1973 period.

It contains data for Mexico of the annual, monthly, weekly, and daily variations of mean sea level, monthly mean atmospheric pressure, sea water temperature and salinity, hourly variations of the MSL on special dates, graphics of the annual variations of MSL for South America, USA and Alaska and monthly mean graphics for wind direction on the West Coast of Mexico.

The data (hourly heights) had been obtained by the Department of Oceanography, Institute of Geophysics, Autonomous National University of Mexico (UNAM), by means of the standard tide gauge network provided by IAGS. The atmospheric pressure data has been provided by the Mexican National Weather Service, and the mean sea water temperature and salinity has been collected in a daily basis during the observations at each tide station.

ANNOUNCEMENTS

15th International Conference on Coastal Engineering (COASTAL-76) at Honolulu, Hawaii

July 11-17, 1976, Hilton Hawaiian Village, Waikiki (see March 1976 ITIC Newsletter for specific details).

Dr. George Pararas-Carayannis has been invited to chair the Tsunami Session of COASTAL-76. Fifteen papers will be presented at the Tsunami Session by authorities from around the world.

Coastal Wave Hydrodynamics - Theory and Engineering Applications

Special Summer Program, Massachusetts Institute of Technology, July 26-30, Summer Session 1976.

A coordinated survey of water waves and wave-induced processes, which are important in coastal engineering, will be presented. Emphasis will be on the basic dynamical principles and mathematical methods of calculations, with illustrative applications. Advances made since the publication of Estuary and Coastline Hydrodynamics (ed. A.T. Ippen, 1965, McGraw-Hill) will be included.

The Program is intended for those with equivalent training of B.S. in Engineering or Physical Sciences. Some elementary knowledge of linear waves will be helpful.

Dr. Frederic Raichlen, Professor of Civil Engineering, California Institute of Technology, will be heading a session specifically devoted to tsunamis.

HONOLULU OBSERVATORY REPORTS

H.O. Receives Seismic Telemetry from Big Island

Honolulu Observatory has enhanced the effectiveness of its interisland seismic net by "tieing in" with seismic sensors operated by the U.S. Geological Survey on the Island of Hawaii. These two seismic signals are telemetered to Honolulu Observatory in real time via the interisland Tsunami Warning System communications net.

According to Mr. Thomas Sokolowski, Acting Geophysicist in Charge at HO, the data from these additional sites are used for evaluating local earthquakes and strong teleseismic events.

Seismic Summary (March 1, 1976 to press-time)

Date and Origin Time (UTC)	Epicenter	Magnitude	Region	Comments
Mar 4 0250Z	15.2 S 167.0 E	7.0	New Hebrides	Press Release
Mar 24 0448Z	29.0 S 177.4 W	6.5	Kermadec Island Area	Press Release
Mar 29 0540Z	3.8 N 85.4 W	6.7	Galapagos Fracture Zone	-
Apr 9 0709Z	0.9 N 78.6 W	6.7	Ecuador	Press Release
May 4 1357Z	44.7 S 168.1 E	6.5	South Island New Zealand	Press Release
May 5 0453Z	30.1 S 177.9 E	6.5	Kermadec Island Area	Press Release
May 15 2156Z	11.4 S 73.6 W	6.5	North Central Peru	Press Release
May 23 0601Z	6.0 S 154.0 E	6.4	New Britain, Solomon Islands	Press Release
May 29 1224Z	26.2 N 99.7 E	6.8	China/Burma Region	Press Release
May 29 1400Z	26.6 N 99.2 E	6.9	China/Burma Region	Press Release
June 3 1644Z	4.9 S 153.5 E	6.8	Solomon Islands	Press Release
June 5 0820Z	10.2 S 160.8 E	6.2	Solomon Islands	Press Release
June 6 1744Z	-	5.0	60 miles Southwest of Adak, Alaska	Press Release from Palmer Observatory
June 7 0737Z	15.6 N 124.9 E	6.3	Philippines	Press Release
June 7 1427Z	17.2 N 98.2 W	6.1	Acapulco, Mexico	Press Release
June 15 0609Z	1.0 N 134.7 E	6.3	New Guinea Area	-